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Copeland—Business Statistics.
 Elderton—Primer of Statistics.
 King—Elements of Statistics.
 Secrist—Introduction to Statistical Methods.
 Thorndike—Mental and Social Measurements.
 West—Introduction to Mathematical Statistics.
 Yule—Introduction to the Theory of Statistics.

There are many that can be added along more general lines, and the *American Statistical Quarterly* and other magazines are furnishing an increasing number of articles on the statistical questions of the day.

Note 2.—Wellesley graduates who have had a one-hour per week course in statistical theory have secured positions in the Statistical Division of the Shipping Board and of the Labor Bureau. Their college work has covered, as completely as was possible in a short course, the collection and arrangement of statistical data, questionnaire forms, classification, graphic representation, computation of averages, percentages and deviations, methods of checking results, index figures, graphic comparison, and correlation.

PROBLEMS FOR SOLUTION.

SEND ALL COMMUNICATIONS ABOUT PROBLEMS TO B. F. FINKEL, Springfield, Mo.

2737. Proposed by C. N. SCHMALL, New York City.

Employing Maclaurin's Theorem, or otherwise, expand the following three functions:

(1) $e^{\tan^{-1} x}$ as far as x^6 ; (2) $e^{\sin x}$ as far as x^8 ; and (3) $\tan x$ as far as x^9 .

2738. Proposed by W. D. CAIRNS, Oberlin College.

Prove that between any two points on a unit circle with its center at the origin there is a point whose coördinates are rational, *i. e.*, prove that the rational points on this circle are dense.

2739. Proposed by JOS. B. REYNOLDS, Lehigh University.

A particle is describing a smooth closed curve in a vertical plane. This curve is three feet high, $19\pi/4\sqrt{2}$ ft. long, and of such form that the pressure is always constant. Find the time of a complete revolution.

2740. Proposed by E. W. CHITTENDEN, University of Illinois.

Establish the identity (the determinant is of order n):

$$\begin{vmatrix} a - \lambda, & a, & a, & \cdots, & a \\ a, & a - \lambda, & a, & \cdots, & a \\ a, & a, & a - \lambda, & \cdots, & a \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ a, & a, & a, & \cdots, & a - \lambda \end{vmatrix} = (-1)^{n-1} \lambda^{n-1} (na - \lambda).$$

2741. Proposed by HORACE L. OLSON, New Hampshire College.

Prove or disprove the following statement: If the three sides and the area of a triangle are integers, at least one of the three altitudes is an integer.

2742. Proposed by C. N. SCHMALL, New York City.

In Gregory's *Examples in the Differential and Integral Calculus*, 1841, Chap. VII, p. 124, ex. 22, I find the following celebrated problem: "To find a point within a triangle from which if lines be drawn to the angular points their sum may be the least possible." The author remarks that "the direct solution of this problem is long and complicated, etc."

Required a simple, brief solution.

2743. Proposed by H. S. UHLER, Yale University.

A certain compound pendulum (Borda) has the geometrical configuration resulting from the following assemblage of parts. The bob is a sphere supported directly by a rod of circular cross-section the axis of which coincides with an extended diameter of the sphere. (The rod does not project below the under surface of the sphere.) The upper end of the cylindrical rod is fitted perfectly in a hole in a rectangular block. The axis of the cylinder is parallel to the four vertical edges of the rectangular parallelepiped and it intersects the lower plane at the center of this rectangle. (The rod does not project above the upper surface of the block.) The knife-edges are formed by a right prism the lateral edges of which are horizontal and the cross section of which is an inverted isosceles triangle. The horizontal lateral face of the prism coincides with the upper plane of the rectangular block. The plane which contains the lowest lateral edge (axis of rotation) of the prism and bisects the associated dihedral angle (median plane) also contains the (prolonged) axis of the rod. The triangular bases of the prism are parallel to, and equidistant from, the respective nearer vertical faces of the rectangular block. All parts are made of homogeneous invar and there are no cavities in the interior of the complete pendulum.

(a) Let R = radius of sphere,

r = radius of rod,

h = length of a vertical edge of the block (height),

t = length of a horizontal edge of the block which is parallel to the lateral edges of the prism (thickness),

w = length of a horizontal edge of the block which is perpendicular to the lateral edges of the prism (width),

l = perpendicular dropped from center of sphere upon the lowest lateral edge of the prism,

a = (vertical) altitude of isosceles section of prism,

b = (horizontal) base of isosceles section of prism,

e = total lateral edge of prism projecting beyond both sides of the block.

For extremely small oscillations of the frictionless pendulum the complete period P_0 may be represented by

$$P_0 = 2\pi \sqrt{\frac{N_1 + N_2 + N_3 + N_4 + N_5}{g(D_1 + D_2 + D_3 + D_4 + D_5)}}.$$

Prove that the symbols under the radical stand for the following expressions:

$$D_1 = -\frac{1}{3}a^2be,$$

$$D_2 = -\frac{1}{2}htw(2a - h),$$

$$D_3 = \frac{1}{2}\pi r^2[(l - R)^2 - (a - h)^2],$$

$$D_4 = \frac{4}{3}\pi lR^3,$$

$$D_5 = \frac{1}{12}\pi k^2[4(l - R)(3R - 2k) + k(4R - 3k)],$$

$$N_1 = \frac{1}{48}abe(12a^2 + b^2),$$

$$N_2 = \frac{1}{12}htw(12a^2 - 12ah + 4h^2 + w^2),$$

$$N_3 = \frac{1}{12}\pi r^2(a - h + l - R)[(a - h + l - R)^2 + 3(a - h - l + R)^2 + 3r^2],$$

$$N_4 = \frac{4}{15}\pi R^3(5l^2 + 2R^2),$$

$$N_5 = \frac{1}{60}\pi k^2[40kR^2 - 35k^2R + 4k^3 + 20(3R - 2k)(l - R)^2 + 10k(4R - 3k)(l - R)];$$

where $k = R - \sqrt{R^2 - r^2}$.

(b) Let $x = l - R$. If the pendulum beats seconds show that x must be a root of the cubic $a_0x^3 + a_1x^2 + a_2x + a_3 = 0$, where

$$a_0 = 80\pi^3r^2,$$

$$a_1 = 40\pi[4\pi^2r^3 - 3r^2(g - 2\pi^2R) + 4\pi^2(R^2 - r^2)^{3/2}],$$

$$a_2 = -20\pi\{4(g - 2\pi^2R)[2R^3 + 3r^2R + 2(R^2 - r^2)^{3/2}] + 3\pi^2r^4\},$$

$$\begin{aligned} a_3 = & -[80\pi^3r^2(h - a)^3 - 120\pi gr^2(h - a)^2 + 60\pi^3r^4(h - a) - 5\pi^2abe(12a^2 + b^2) \\ & - 20\pi^2htw(12a^2 - 12ah + 4h^2 + w^2) - 80ga^2be + 120ghtw(h - 2a) - 224\pi^3R^5 \\ & + 160\pi gR^4 - 320\pi^3r^2R^3 + 240\pi gr^2R^2 + 60\pi^3r^4R - 60\pi gr^4 - 16\pi(14\pi^2R^2 + \pi^2r^2 \\ & - 10gR)(R^2 - r^2)^{3/2}]. \end{aligned}$$

(c) Given $a = 1$, $b = 0.8$, $l = 2$, $g = 980.5$, $h = 2$, $P_0 = 2$, $r = 0.49/4$, $R = 12.01/4$, $t = 0.64$, and $w = 1.2$; calculate l correctly to four, or more, decimal places.

(d) Compute the percentage error affecting the result if g were calculated from the true value of the period (2 secs), as obtained experimentally, while neglecting all moments of forces and of inertia except those pertaining to the spherical bob.

2744. Proposed by E. B. ESCOTT, Chicago, Ill.

An insurance company computes its quarterly premiums by adding 6 per cent. to the annual premium and dividing by 4. If a policyholder pays quarterly, what rate of interest is he paying?

2745. Proposed by G. I. HOPKINS, Manchester, N. H.

A recent English publication contains the following method of constructing a regular polygon of 17 sides: Draw the radius CB perpendicular to the diameter AQ of the circle whose center is B . On BC lay off BD equal to one-fourth of BC . On BA , lay off BE and draw DE making angle BDE one-fourth of angle BDA . On BQ lay off BF and draw DF making angle FDE 45° . On AF as diameter, construct semi-circle FRA intersecting CB in H . With E as center and EH as radius construct semi-circle LHK intersecting CB in H . At the points L and K draw the ordinates NL and MK . Bisect the arc NM and let P be the point of bisection. Then the chord $NP(=MP)$ is a side of the regular polygon of 17 sides. Is the method of construction correct?

SOLUTIONS OF PROBLEMS.

433 (Calculus). Proposed by LOUIS O'SHAUGHNESSY, University of Pennsylvania.

Solve the differential equation, $\frac{d^{1/2}y}{dx^{1/2}} - \frac{y}{x} = 0$.

DISCUSSION BY EMIL L. POST, Columbia University.

In the April number of the MONTHLY appeared two solutions of the fractional differential equation

$$\frac{d^{1/2}y}{dx^{1/2}} = \frac{y}{x}. \quad (1)$$

The first of these, $y = Cx^{-1/2}e^{-1/x}$, was obtained by reducing the given equation to an ordinary differential equation of the first order; while the second, $y = A_0(1 - i\sqrt{\pi}x^{-1/2} - 2x^{-1} + i\sqrt{\pi}x^{-3/2} + \dots)$ was found by equating coefficients in an assumed expansion in series. Now each of the two methods used would seem to indicate that only one solution was possible, i. e., the solution found by the corresponding method, yet the two solutions are clearly irreducible. A discussion of this difficulty might serve as a beginning of that more thorough discussion of the subject which the proposer of the problem desires.